

CLAIMS

1. An arrangement for non-destructive inspection of joint
5 layer(s) in a multilayer structure (40;41-45) comprising at
least a first layer (1) with a first outer surface, a second
layer (2) with a second outer surface and a joint layer (3) for
joining said first and second layers,
c h a r a c t e r i z e d i n
10 that it comprises a heating arrangement (10) for homogeneously
heating up said second outer surface of the multilayer structure
(40;41-45), a detecting arrangement (20) comprising a
thermographic imaging system for registering the infrared
radiation pattern representative of the temperature distribution
on said first outer surface of the multilayer structure (40;41-
45) and processing means (30) for, based on the temperature
distribution, establishing at least the eventual presence of (a)
cavity/cavities in the joint layer (3).
- 20 2. An arrangement according to claim 1,
c h a r a c t e r i z e d i n
that the thermographic imaging system comprises an IR-radiation
detection equipment (20).
- 25 3. An arrangement according to claim 1 or 2,
c h a r a c t e r i z e d i n
that the heating means (10) comprises a heating plate, or laser,
a lamp or similar enabling a fast heating up of the second outer
surface of a multilayer structure (40;41-45).
- 30 4. An arrangement according to claim 1,2 or 3,
c h a r a c t e r i z e d i n
that the detecting arrangement (20) is used to detect the
infrared radiation pattern representative of the temperature

distribution on the first outer surface substantially simultaneously with the heating up of the second outer surface to register the transient process of heat transport across the multilayer structure.

5

5. An arrangement according to any one of claim 1-3, characterized in that the detecting arrangement (20) is activated before a substantially homogeneous temperature distribution has been reached on the first outer surface.

10

6. An arrangement according to claim 4 or 5, characterized in that the processing means (30) comprises a processing system for, based on the registered temperature distribution information, detecting cavities of at least a given minimum size.

15

7. An arrangement according to claim 4,5 or 6, characterized in that the processing means (30) comprises a processing system able to determine the size and/or dimensions of cavities of at least a given minimum size.

20

8. An arrangement according to any one of the preceding claims, characterized in that it is used for automatic on-line operation such that a number of subsequent multilayer structures (41-45) can be inspected, which structures are arranged to move in relation to the arrangement.

25

30

9. An arrangement according to any one of claims 1-7, characterized in that it is mobile.

10. An arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that it at least is manually operable.

5

11. An arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that it is automatically operating.

10

12. An arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that it is used to inspect multilayer structures in which the
thermal conductivity coefficients of the first layer (1) and of
the joint layer are lower than that of the second layer (2).

5

13. An arrangement according to claim 12,
c h a r a c t e r i z e d i n
that the coefficient of thermal conductivity of the first
layer(s) (1) is/are lower than approximately 50 [W/mK].

10

14. An arrangement according to claim 12 or 13,
c h a r a c t e r i z e d i n
that the joint layer (3) comprises a polymer based material,
e.g. a thermoplastic material, a thermosetting layer, an
25 adhesive film or similar.

15. An arrangement according to any one of the preceding claims
used for inspecting joints (3) in multilayer structures (40;41-
45) in which the second layer (2) comprises a metal, a metal
30 alloy, composite, or graphite, the first layer (1) comprises a
ceramic material, e.g. alumina, LTCC or a polymer, such as FR4
plates, or a metal alloy.

16. An arrangement according to any one of the preceding claims,

c h a r a c t e r i z e d i n

that the heating arrangement (10) heats up the second layer (2) from e.g. about room temperature to a temperature of approximately 200°C or below that, preferably to a temperature
5 between 100-150°C, or from another temperature with an amount appropriate for detecting cavities.

17. A method for non-destructively inspecting joint layers in a multilayer structure comprising at least a first layer with a
10 first outer surface forming one of the outer surfaces of the multilayer structure, and a second layer with a second outer surface forming the opposite outer surface of the multilayer structure and a joint layer for joining said first and second layers,

c h a r a c t e r i z e d i n

that it comprises the steps of:

- providing the structure between a heating arrangement and a detecting arrangement;
- heating up the second layer/second outer surface
15 homogeneously;
- establishing the temperature distribution on the first outer surface by means of a thermographic imaging system;
- analyzing the temperature distribution pattern for detecting cavities or voids in the joint layer.

18. A method according to claim 17,

c h a r a c t e r i z e d i n

that the step of establishing the temperature distribution comprises the steps of:

- 30 - recording the infrared radiation pattern emitted from said first surface, by means of an IR-radiation detection equipment;
- converting the emitted infrared radiation pattern to a temperature distribution pattern.

19. A method according to claim 18,
c h a r a c t e r i z e d i n
that it comprises the step of:

- 5 - manually providing the multilayer structure in a position
enabling inspection between the heating arrangement and the
thermographic imaging system.

20. A method according to claim 18,
10 c h a r a c t e r i z e d i n
that it comprises the steps of:

- automatically feeding a plurality of subsequent multilayer
structures on a line into position for inspection;
- operating an IR-detection equipment forming a thermographic
5 imaging system for subsequently arriving multilayer
structures.

21. A method according to any one of claims 16-20,
c h a r a c t e r i z e d i n
20 that it comprises the steps of:

- applying heat to the second layer(s) in a manner allowing
fast heating up;
- activating the detecting arrangement substantially
simultaneously with heating up to allow recording of the
25 transient procedure of heat transport on the first outer
surface.

22. A method according to any one of claims 16-21,
c h a r a c t e r i z e d i n
30 that it comprises the steps of:

- heating up the second layer from e.g. room temperature to a
temperature of approximately 200°C or below that; preferably
to a temperature between 100-150°C.

23. A method at least according to claim 18,
c h a r a c t e r i z e d i n
that it comprises the step of:

- evaluating the temperature distribution pattern using a
5 processing system to at least determine the size of cavities
exceeding a given value.

24. A method according to any one of claims 16-23,
c h a r a c t e r i z e d i n
10 that it comprises the steps of:

- providing reference values on temperature distribution
patterns corresponding to cavities of a given size;
- comparing obtained temperature distribution patterns/
temperature values with said reference values to determine
the size(s) of cavities.

25. A method according to any one of claims 16-25,
c h a r a c t e r i z e d i n
that it comprises the steps of:

- defining a maximum limit for the size of acceptable cavities;
- comparing the size(s) of a detected cavity with said maximum
value;
- automatically activating an alarm if a joint layer contains a
cavity/cavities exceeding said maximum value.

26. A method according to claim 25,
c h a r a c t e r i z e d i n
that activation of the alarm leads to the step of; for on-line
operation,

- 30 automatically indicating a multilayer structure having a
joint layer with one or more cavities with a size exceeding
the maximum value.

27. A method according to any one of claims 16-26,

c h a r a c t e r i z e d i n

that the second layer comprises a metal, metal alloy, composite or graphite or similar, that the first layer comprises a ceramic material or a metal alloy or composite such as Kovar, and in

5 that the joint layer comprises a polymer, e.g. a thermoplastic material, a thermosetting material, an adhesive film etc. and in that the second layer has a coefficient of thermal conductivity which is comparatively high whereas the first layer and the joint layer have coefficients of thermal conductivity which are
10 comparatively low such that heat is not too quickly transported.

10001290 11010101